
Nk'pux Lake
Fish Potential Assessment
2023 to 2025

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Introduction and Background

Arsenault Environmental Consulting Ltd. (Arsenault) is pleased to provide the following summary report for a fisheries and NK'pux Lake health assessment to Kanaka Bar Indian Band (the Client). The services specifically relate to a lake condition assessment to determine the potential for the headwater lake (the Site) to support a food-fishery for members of the Kanaka Bar Indian Band. This program is intended to help community members to create a management plan for the creation of a sustainable fishery at the lake.

There are two lakes at the headwaters of Siwash Creek, which is a small second order stream that flows to Fraser River near the community of Kanaka Bar. There is evidence that one of the two lakes once supported rainbow trout (*Oncorhyunchus mykiss*) in sufficient numbers to provide food to people of Kanaka Bar. Pit houses have been discovered near the lake. It is called NK'pux Lake. Traditional knowledge keepers have reported that fish were harvested from the larger of the two lakes during the 1960s and up to 1972. Helicopter pilots told Arsenault that BC government fisheries workers used to stock lakes in the region by helicopters in the 1960s. This is likely what occurred.

The winter of 1972 was a big snow season. It is probable that the snow was so deep that the blanket it created on the lake resulted in the complete blockage of sunlight. This would result in the loss of oxygen production by phytoplankton. The fish that were in the lake would have used up the oxygen and died before the ice came off. Scavengers would have picked up the fish after ice-off. Knowledge keepers reported that there were no fish in the lake during the summer of 1973.

The Aquatic Habitat Restoration Fund (AHRF) made it possible to conduct three visits to the lake. See below a summary of what was found during the late spring / early summer visit of 2023. There was no late summer visit during 2023 due to wildfires. There was a winter survey during March 12, 2024, when lake water samples and a sediment core were collected. That information is included in this report. A summer survey was completed during 22 July 2024.

The participants in the spring 2023 field tour / data collection visit were Domonique Sansom (Land Guardian), Sean O-Rourke (Land Manager), Darryl Arsenault (Professional Biologist), Mitch Olson (Biologist in Training), and Jake Veenman (archaeology technologist).

Field Visit Summary for Summer of 2023

We flew into the lake by helicopter on 5 July 2023. There was a helicopter landing pad near the northwest corner of the lake. Some modifications to the timber pad were required before equipment could be unloaded. The area was wet with groundwater drainage through most of the small meadow.

We followed a trail to look for a camp. It was too wet on the north side of the lake and creek. We found a camp area on the south side of the creek mouth at the west end of the lake. There was a small fire pit and what looked like flattened areas that could have been tent sites. We camped at the old camp site where there was fresh water and dry ground.

We had three people doing lake and stream surveys and two people doing archaeological work. Crews stayed in touch with each other with two-way radios.

We were there from 5 to 8 July 2023. The weather was perfect with sunny days and only one rain shower on the 8th. It was windy on that day as well. This made taking off with the helicopter a bit risky.

Mosquitoes were bad. Bug nets were essential. Bug spray ran out quickly and didn't work well when we had it.

The lake was very clear with visibility to about 13 to 15 metres, as measured with a Secchi disk. Clear water is indicative of a low productivity lake. This is what we would expect in a headwater lake high in the mountains.

Few bugs were noted in the water except for the odd shrimp (*Gammarus* sp.) and midges (Chironomidae) and some mayflies (Ephemeroptera). There were three types of caddisflies (Tricoptera or sedges) detected in shallow water near the inlet stream. There was a midge hatch on the lake at about noon of the 3rd day (7 July). The insects noted means that there is fish food available. These same insects indicate that the water quality is good.

Long toed salamanders were common around the lake and at the outlet creek. These would also be eaten by fish, which wouldn't eliminate their presence but could reduce their numbers in the area. It is likely that they are currently the top aquatic predator, other than a family of Barrow's Goldeneye (*Bucephala icelandica*). A pair of these birds was raising a family on the lake. This species nests in cavities of tall trees near lakes and the entire family eats aquatic insects, and maybe small salamanders. These Goldeneye (diving ducks) appeared to have nested in a tree along the northeast shore area. There were 5 live chicks seen with the parents after the second day at the lake and one egg was noted on the last day in about 3 m water depth below a tree that was leaning out over the lake. Goldeneyes nest in cavities of trees next to lakes. No other waterfowl were seen.

No fish were observed or captured in gill nets, which were set for two nights. Fish finders were used as well. No fish were indicated on the sonar.

There is a small section of gravel habitat at the inlet stream at the east end of the lake that would provide moderate fish spawning potential. It could be possible to enhance its spawning habitat quality. The stream gradient becomes too steep for fish within 35 m of the lake.

There is a flat stream area on a bench about 120 m to the east of the lake. Fish could survive here but there is very little cover or food noticed. It is too shallow (<1 m deep) to allow fish to overwinter.

A few frogs were heard calling at the inlet stream area, and up on the bench above the lake. It wasn't an ideal time to conduct frog surveys. A better time is in mid to late-May.

A 16-foot fibreglass canoe has been brought to the lake. There are paddles with the canoe. It is kept near the camp. It survived the fire. An electric motor was also left with the canoe in 2023, as well as solar panels to charge the batteries. One battery was left at the lake, but it is probably no good after being stored there for one year, especially over winter. The motor, solar panels, and batteries were removed from the camp at the end of the summer 2024 survey.

The outlet stream has several sections of good quality fish spawning habitat. There is a log jam at the outlet that could impede fish passage into and out of the outlet stream. Logs gathered at the outlet streams of natural lakes is typical and provides lots of cover for fish food. This is where many salamanders were observed.

There are several large boulders on each shore that would be good spots from which to fish, if there were fish in the lake. These features have been shown on the attached map.

NK'pux Lake is 0.441 km long and 0.281 km wide. The lake is about 26.5 m (87 feet) deep at its deepest and averages about 72 feet deep in the deep-water area. The average lake depth is 12 m. About 1/3 of the lake is in the 22 m deep zone. This means that there is a large volume of water for fish. The volume estimate is 1,481,760 m^3.

Water quality in the lake appears good. The dissolved oxygen meter was not working properly during the spring 2023 survey. We confirmed water quality during the next two surveys. The water temperature was about 15 to 16 degrees C (about 69 F) during early July 2023.

Water samples were collected for chemical analysis from the deepest part of the lake and from the inlet and outlet streams. Water chemistry results indicate that there are no chemical contaminants of detectable levels. All results indicate that the lake is clean and suitable for fish. Results are provided in Appendix C.

There are many fallen trees on the lake bottom especially near the outlet and along the south shore. See the habitat map on the following page for more information and the attached photos of each habitat reach for additional details.

Field Visit Summary for Winter - March 2024

The winter survey was a challenge to plan and complete. It was a winter with much less snow than normal. There was only 35% of normal snowpack in the Lower Fraser Snowshed during January of 2024 (River Forecast Centre 2024). By early February, the snowpack in the Lower Fraser Snowshed was still only at 47% or normal. On March 1, 2024, there was 61% of normal snowpack in the same area. It was raining in the lower valley areas and some snow was accumulating in the mountain areas. There was an increasing chance of higher than normal seasonal temperatures and recent snow on Jackass Mountain. The team decided that early March was the best time to sample the lake when the snow would be deepest on the lake and most likely to influence lake water quality.

The biology team of Brook Arsenault and Darryl Arsenault drove from West Kelowna to Boston Bar to meet with the team assembled by Sean O'Rourke, which included him, Mary-Jo Michel, and Jeremy Williams. Getting to the lake was a challenge. The weather was unsettled with low clouds on March 11, 2024. Helicopters could not fly us to the lake. We met during the morning of March 12, 2024, waiting for helicopter pilots to give us some good news. It was rainy again. The helicopter that was planning to pick us up from Hope could not take off. Finally, later in the day a helicopter from Merritt flew to meet Brook and Darryl at a fuelling station that Valley Helicopters maintains across the highway from Canyon Alpine Motel in Boston Bar. The rest of the crew had already departed thinking there would not be a chance to fly that day. The helicopter did finally get the biology crew up to the lake at 1540 hours on March 12, 2024. It was a slow climb with icy rain making us retreat once. We finally made it into the lake at about 1600 hours. Weather was still unsettled so the pilot kept the chopper running. The air temperature was -5°C and it was sunny on the lake.

GPS was used to relocate the deepest part of the lake. This was very close to where the helicopter landed and due to time restrictions, the hole in the ice was drilled right beside the helicopter. The snow depth was 80cm and the ice depth was 55cm. The shovel first used broke while digging, thank goodness we had a backup. The water's surface temperature was 0°C. The amount of oxygen in the water (Dissolved Oxygen) needs to be above 5mg/L for rainbow trout and sockeye salmon to survive (Scott and Crossman 1998) and fortunately until a depth of 22m this level was between 5 and 12 mg/L. Below 20m depth, the Dissolved Oxygen level was below 5 mg/L so fish will avoid those depths. From the surface, we could see some blood worms and red rotifers, which are a great food source for fish. A sediment sample and a surface water sample were taken from this same hole. The water samples were taken from the core tube prior to sediment removal. Wate was poured out the top with the first sample labelled Water 2 and the second sample labelled Water 1. Note that the lower sample had some sediment stirred up from the core sample and the higher concentrations of most parameters reflects the influence of the soil.

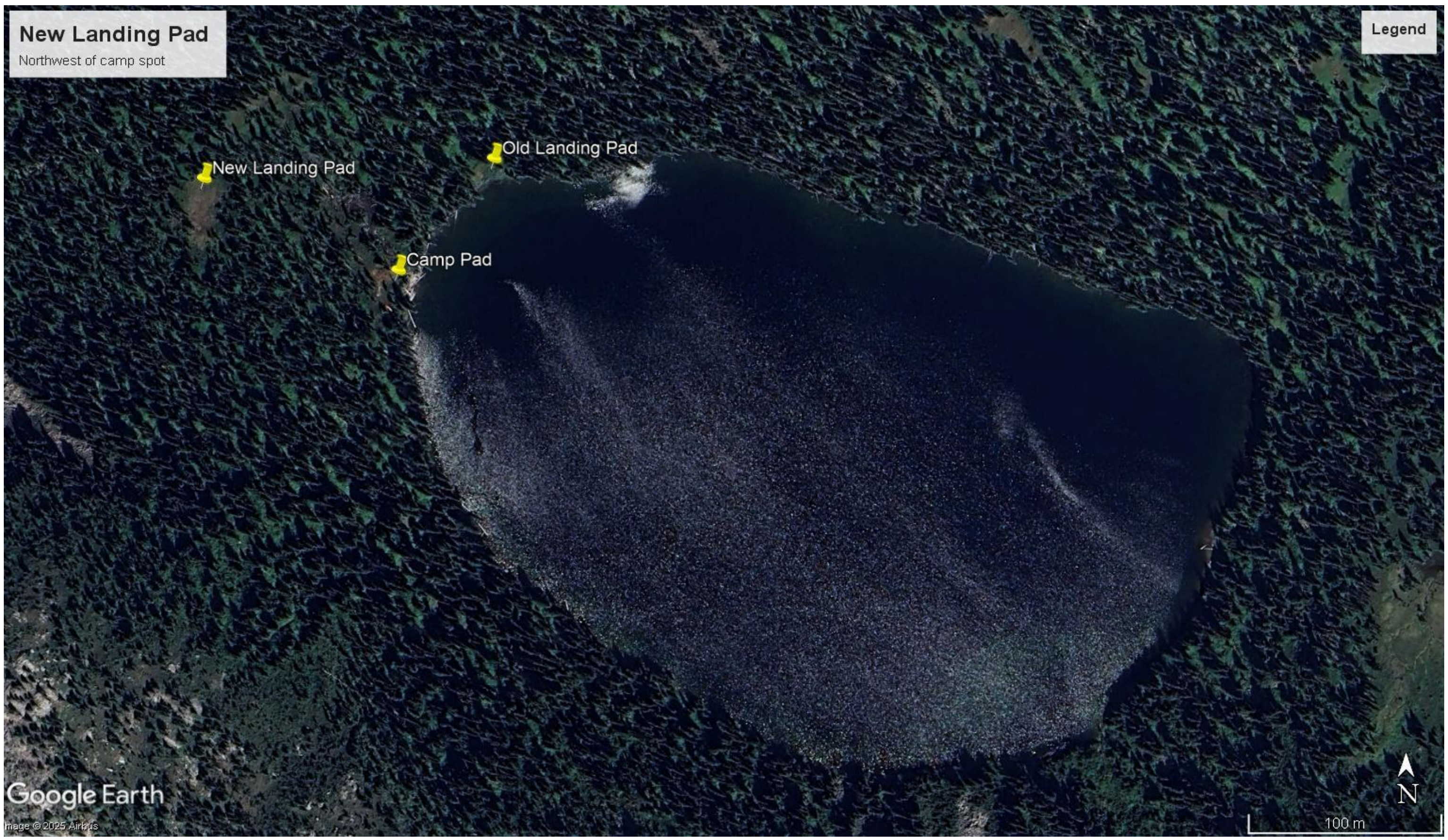
Duplicate water samples were collected from the lake bottom to see how results vary between two samples. A surface water sample was also collected. Caro Analytical Services completed the lab testing. It is interesting to note that the surface sample was quite low in most elements tested. This likely reflects the similarity the sample would be to snow melt water. The two bottom water samples tested above detection for most metals but still in relatively low levels. They were duplicates, so it would be expected that their results would be the same. For example, pH in Duplicate Sample 1 was 7.54 and pH in Duplicate Sample 2 was 6.12. This is notable, and the second result was like the surface water result of pH 6.17. Other slightly elevated parameters in the lake bottom water samples include total phosphorus (1.56 & 1.64 mg/L), total Kjeldahl Nitrogen (4.57 & 4.48 mg/L), and calcium (10.4 & 7.8 mg/L). The soil sample pH was 8.76. There were relatively high levels of aluminum (34,100 mg/kg), iron (26,300 mg/kg), and manganese (387 mg/kg) in the soil. This is not unusual. A request for the lab to test for Total N/P/K and TKN in soil was not fulfilled.

A dissolved oxygen and temperature profile was collected through the ice. Results are provided in a chart in Appendix B and discussed at the end of the next section.

Results are provided in Appendix C.

Field Visit Summary for Summer July 2024

We flew in on July 22nd by helicopter. We landed in a different area that was flatter and more spacious than last summer. The new spot was more northwest from the camping pad and away from the lake. See image from Google Earth below that shows the new landing location.



There were two people doing the lake and stream surveys (Darryl Arsenault and Brook Arsenault), two people doing the archaeological work (Mary Jo Michell and Sean O'Rourke) and one person doing videography of the works (Jeremy Williams). Crews stayed in touch with two-way radios.

The helicopter took three flights to get crews and supplies dropped near the campsite. After we were flown in, the elders were given a fly over in the helicopter of the Kanaka Bar territory.

We were there from July 22nd to 25th 2024. The weather was dark and cloudy most of the time with head nets crucial at most times due to very active mosquitos. The only time the head nets were unnecessary were during windy times, in our tents, or in the canoe on the lake. The temperature during the day was between 10°C and 25°C and at night it got down to 7°C with wind chills. The no-fire policy set by Kanaka Bar Indian Band was followed. This made for early nights huddling in our tents. It would have been nice to have the heat of fires to keep us warm and ward off mosquitos.

After flying in, we looked to see the condition of things left behind. The cot cover was chewed through, presumably by mice or another rodent of similar size. Support for this presumption comes from the rodent activity under and around the tents during our presence. There was also a large bite mark with four punctures in the battery that must have come from a larger animal, i.e. a bear. We put water from the lake in the battery, taped it up and tested to see if it would hold a charge with solar panels (also chewed up a bit) that were left behind from the summer 2023 trip. The battery did hold a little charge.

This lake was found to be of low productivity, with very clear water and very little plant growth.

So what is low productivity? This is essentially the amount of life that the lake can produce. This starts with the amount of nutrients in the lake, mainly Phosphorus and Nitrogen. Since Nk'Pux lake is a headwaters lake, meaning it is the first lake in the watershed, there is very little forest input into this lake. This means very little leaves and sticks, and other organic matter falling into the lake to be decomposed. Decomposition is the main source of nutrients. Being that this lake is nutrient poor, the water is very clear water allowing you to see the lake bottom and its logs, rocks and boulders. In this lake the depth that can be seen down with the eyes is 11.2 m as measured with the Secchi disk. No aquatic plants could be seen on the lake bottom, which in terms of fish being introduced, would be a disadvantage due to lack of habitat. Even though this lake is of low productivity, when fish are introduced, they tend to cycle nutrients tied up in sediment and return the aquatic ecosystem to a more productive state. This lake, however being of low productivity, still supports many invertebrate populations as shown in Table 1. This will provide food for the introduced fish. External food sources, such as terrestrial insects, will also provide fish food.

General observations, or what animals and invertebrates were seen or heard included these species. Caddisfly casings with and without the caddisfly. Some caddisflies were seen feasting on a dead and decaying long-toed salamander in about 10 cm deep water at the creek outlet. This was the only long-toed salamander seen on this trip, which is peculiar due to the abundance of this species during the last NK'pux trip in early summer of 2023. Salamanders would be a good food source for the larger introduced fishes. There was a mayfly hatch on the last day at camp.

It is noted that fish may eliminate the salamanders out of the lake, but these salamanders will remain upstream and downstream of Nk'Pux Lake where fish cannot access due to shallow waters and gradient barriers.

Hermit Thrushes were heard singing, and one approached within 2.5m of Darryl. A small Bufflehead Duck was seen. A male, female and juvenile Barrow's Goldeneye ducks were seen on the lake. A loon was seen and heard calling out by Mary-Jo.

Since Mary-Jo had a little trouble sleeping at nights, she woke up and heard frogs coming from the east end of the lake around midnight, most likely from the plateau above the lake. Frogs were also heard during the visit of Summer 2023 from the same area. Frogs were not seen or heard near the lake outlet or at any other area around the lake during either of the two July surveys.

The small creek by the east edge of the cliff in zone 10/11 had a trickle of water running down. The gradient is quite steep as it runs down off an avalanche track. It would not provide fish habitat.

There were a substantial number of mayflies seen by general observation flying in the thousands around the tents in the afternoon, coming off the lake, as in a mayfly hatch, as well as in the benthic sample results.

Benthic kicking samples were done at the creek inlet (3 samples, south of stream, north of stream and in mouth of stream) end of the lake in shallow waters between 0.1-0.45 cm water depth following CABIN protocol. This sampling was done by shuffling backwards with the feet which stirred up the lake bottom while holding a (500 µm) D-Net and sweeping it back and forth and bouncing it off the bottom to collect what was stirred up. What was collected into the D-Net included sediment and the main thing we were looking for in this sampling, invertebrates. With our eyes, we could see some dragonfly larvae (Aeshnidae and Anisoptera) and scuds (Gamarus). These samples were preserved in Formalin. The results of benthic sampling are shown in Appendix Table A1. The substrate at the inlet creek was 90% gravel, 10% sand and lots of organics like sticks, and fir needles.

So benthic kicking samples were done to find the invertebrates present within the lake bottom in shallow zones, but what invertebrates were present in the water column? This sampling is called zooplankton collection. We used a cone shaped net with very, very fine netting (400 µm), an opening of 30 cm tapering into a small collection cup. This device is called a zooplankton net (see photos). First, we located the deepest part of the lake which was identified in Summer of 2023 using a depth finder, anchored the boat in place, then we took three samples in the same spot. To take the samples, we lowered the net down to the end of the rope and then at a constant speed of 1.3 meters per second, Brook pulled up the net. The samples were then kept in plastic jars and preserved using ethanol. The results are shown in Appendix Table A1. Before preservation, many invertebrates including scuds and shrimps (Gammarus) and water boatmen (Corixidae) were seen swimming around (photos). One additional sample was kept alive to provide to the identification laboratory. They appreciated the chance to observe the little organisms under a microscope when they are alive. Invertebrate identification and counting were completed by Cordillera Consulting Inc, a small company located in Summerland, BC.

Water quality was tested in locations in the creek and lake. Water temperature, pH, Dissolved Oxygen (DO) and Percent Dissolved Oxygen were measured. All data are in Appendix B Table B2.

Dissolved oxygen and temperature were successfully measured at the deepest point in the lake in Summer 2024 and Winter 2024. The temperature is not irregular, and the DO gradient is as expected. The bottom of the lake stays at around 4°C all year. Water is most dense at 4°C. In winter, the surface of the water stays at close to 0°C. In the summer, the top of the water is warmest and at about 4m, the water temperature drops rapidly. This is called the thermocline. Rainbow trout prefer a temperature between 7-18°C with their upper lethal temperature being 28°C (Ineno *et al*. 2020). Colder water can hold more oxygen. This means that in the winter, water closer to the surface has more oxygen as it is colder. More dissolved oxygen means more oxygen available for the fish to use. In the summer, the higher dissolved oxygen layer is in the thermocline. In the summer, the dissolved oxygen level at the surface is lower due to high temperatures allowing water to release oxygen into the air decreasing the amount of oxygen in the water. These data are shown in graphs in Appendix B, Figure B1, Figure B2, and Figure B3.

Fish Stocking Recommendations

Rainbow trout were found in Siwash Creek between the railway culvert and highway culvert during 2002 (Arc Environmental 2002). A lake survey was conducted during summer 2012, which resulted in the conclusion that no fish were present in either of the two headwater lakes at that time (Triton 2012a). A second survey conducted during 2012 only found rainbow trout below the railway culvert (Triton 2012b). The fish found between the two culverts during 2002 were likely a vestigial fish population from the lake (Triton 2012b). Triton (2012b) made a statement that fish are very unlikely to migrate upstream past the railway culvert. Based on the 2012 sampling results, there may still be fish in lower Siwash Creek (below the railway) 53 yrs after fish died off in Nk'Pux Lake during the winter of 1972. According to Triton (2012b), it is possible that rainbow trout found below the railway could come up from Fraser River during high flow events when looking for refuge.

The lake appears suitable for a fish stocking program. There were no rare and endangered aquatic species observed at the lake. Long-toed salamanders were found in moderate quantities in spring 2023 but only one dead individual was observed in early summer 2024. No other amphibians were seen or heard in the lake. Some frogs were heard in the wetlands on the plateau above the lake. Water quality is adequate, although on the low productivity end of the scale. There are adequate feed sources from littoral and profundal benthic invertebrate sources. There would also be food from flying and drifting insects from the surrounding watershed. Although much of the productivity (in the form of nutrients to support fish food) is currently tied up in lake sediments, introduction of fish to the system could result in resuspension of such nutrients making them available for increased food production. In other words, the presence of fish would be expected to increase the overall lake productivity by putting nutrients that are currently bound up in the sediment back into circulation.

There are plenty of gravel shore areas to provide potential shore spawning habitat for spring and fall spawning fish species. The inlet stream could provide a small amount of habitat within the gravel delta at the mouth. The first 17 m of the stream is of adequate gradient (about 5%) to allow fish passage. After that point, the stream gradient increases to >25% with several substantial rock drops in the cascade pool sequence before the stream flattens out on the plateau above. Fish could not reach the plateau section without help.

The lower 17 m of the inlet stream could be enhanced to create better spawning habitat. Water flow appears adequate. A series of 3 rock or log weirs could be created by hand labour. Gravel could be added between the weirs to create spawning benches. If this work was completed, the natural recruitment of fish could decrease the need for a yearly restocking program.

The fish species recommended for lake stocking include sockeye salmon and rainbow trout. These two species use different parts of the lake for feeding, and although the species are related, they spawn at different times of the year. Rainbow trout spawn during spring and sockeye salmon spawn during fall. They both spawn on lake shores and in inlet streams. Rainbow trout have been successfully stocked in the lake circa 1960. There are no provincial records of stocking. Anecdotal records from helicopter pilots at Valley Helicopter (B.

Fandrich, personal communication, 2023) indicate that stocking records may have not been kept of the stocking event, which would have happened via helicopter. Regardless of where they came from, they survived in the system until the winter of 1972 when the deep snowpack that year likely resulted in the winter-kill of the species. That was an unusual winter that resulted in extreme floods in the Fraser system during spring 1973. If they were stocked in 1960, they could have spawned naturally for several cycles before the perished.

The provincial fish stocking program will need to be contacted to discuss stocking options if rainbow trout are the fish of choice (A. Klassen, personal communication, 2025). The province will not supply fish to private ventures. Their policy is to stock triploid fish, which cannot breed, in waters that are accessible to all residents of BC. Fisheries and Oceans Canada manages sockeye salmon stocks. It may be possible to stock the lake with sockeye salmon. Okanagan Nation Alliance has a hatchery in Penticton, BC, and may have fish that could be purchased to stock the lake (with appropriate permissions from DFO and support by the Penticton Indian Band). Non-indigenous fish species such as brook trout could not be stocked in the lake.

If Kanaka Bar wishes to stock the lake with fish, it is possible that they could reproduce successfully along the shorelines or in the inlet stream. Sockeye salmon may be the fish of choice. This would likely be the best fish to stock since complications of the provincial fish stocking program could be avoided. Enhancement of the inlet stream would improve the success of creating a self-sustaining fish population.

Sockeye salmon rear in lakes for one to two years (Scott and Crossman 1998). Smolt may decide to descend to Fraser River after one, two, or even three years (depending on growth rates). Some fish could decide to stay in the lake to complete their life cycle. This would result in a Kokanee population. Alternatively, the lake could be stocked with Kokanee. Regardless of the stock of sockeye salmon that would be introduced to the lake, some would likely migrate downstream to the Fraser River at some point in their life cycle. These fish could successfully make it to the ocean to complete their life cycle, and if successful could end up back at the mouth of Siwash Creek when they area ready to spawn.

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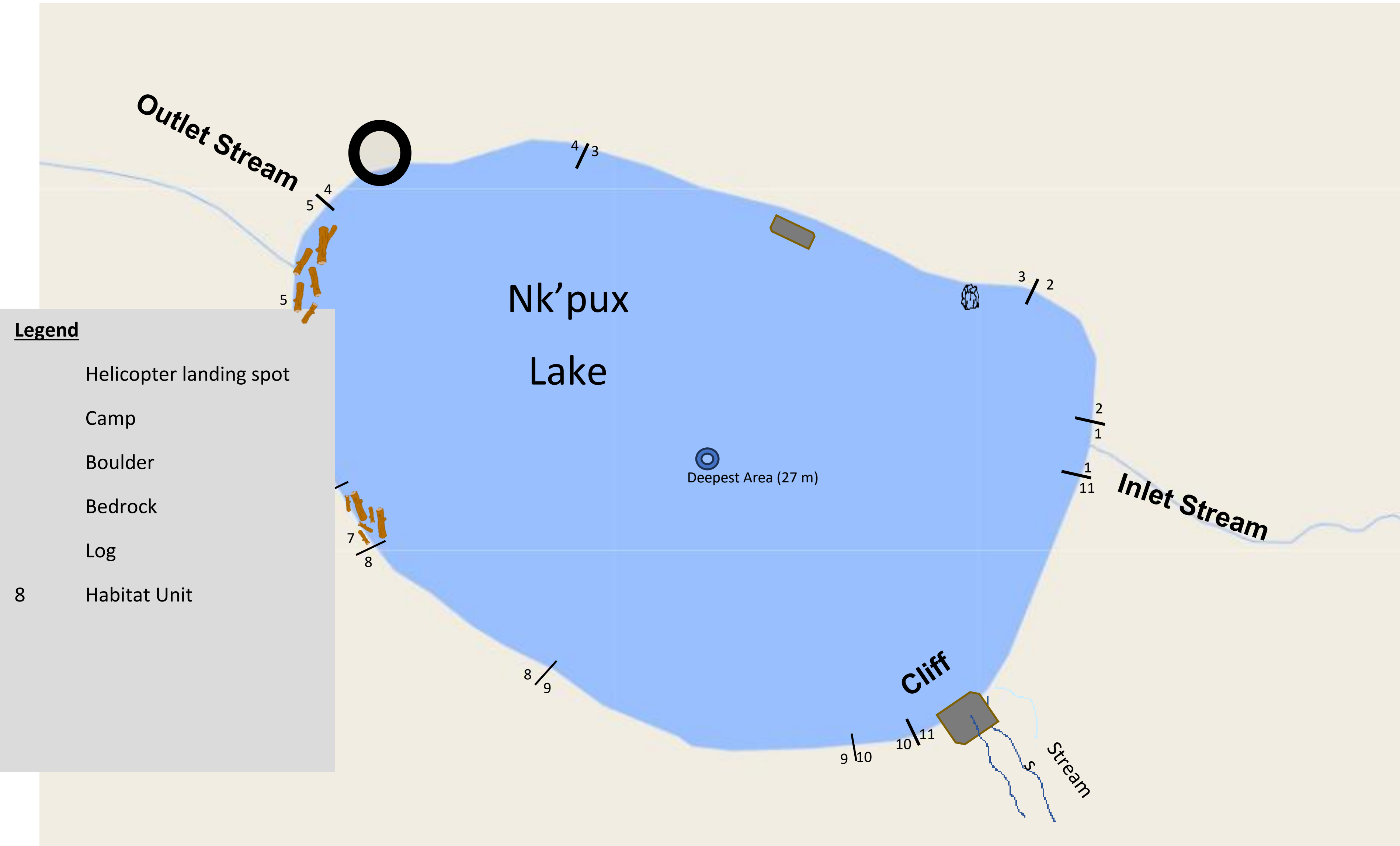
Appendix A – Habitat Map and Descriptive Pictures

Figure 1. Nk'pux Lake Habitat Map (description provided below the figure)



Lake Habitat Zone Description – 11 Units

1) Inlet Creek Mouth – High value spawning gravel and clean water flow
2) Gravel band by shore – Potential Spawning
3) Cobble at shore, some overhang, LWD – Negligeable Spawning potential
4) Long littoral zone, cobble and gravel – Low potential for spawning
5) At west end, creek outlet, rafting of logs
6) Descent fish habitat – Some LWD
7) Gravel amongst rafted logs
8) Short littoral zone, cobble and gravel – Nice Spawning bench
9) Very Short Littoral zone, cobble, gravel and boulders on slope with lots of structure (boulders and logs), probably good fishing – negligible spawning potential
10) Gravel patches with steep drop-off – Potential Spawning
11) Short littoral zone, gravel and cobble, long slope – Some spawning potential

Zone 1

There is a small section of gravel habitat at the inlet stream at the east end of the lake that would provide moderate fish spawning potential. It could be possible to enhance its spawning habitat quality. The stream becomes too steep for fish within 35 m of the lake.

A few frogs were heard calling at the inlet stream area during early July. However, the ideal time for frog surveys wasn't during the summer months. The best time to survey for amphibians is just after ice-off (likely late May or early June).

Photo 2. This is the inlet of N'kpux lake, the photo was taken with a drone. There is a flat stream area on a bench about 120 m to the east of the lake. Fish could survive during summers here but there is very little cover or food noticed. The stream could freeze to the bottom during winter.

Photo 3. This shows the inlet stream on the sub-alpine plateau above the lake. Lots of seepage water from the steep slope to the right.– July 2023. Frogs were seen and heard here.

Photo 4. Habitat unit 1 is at the mouth of the inlet stream and could be used as spawning habitat by trout or Kokanee.

Zone 2

Photo 5. An aerial photo with Habitat Zone 2 at the bottom (orange line). – July 2023

Photo 6. Typical habitat in Zone 2 with large flat rocks and a band of gravel next to overhanging banks.

Zone 3

Photo 7. Typical representation of Habitat Unit 3. Cobble along shore would not provide spawning habitat for salmonids.

Photo 8. The flat bedrock in habitat Zone 3 can be seen in this photo.

Photo 9. One of these two large trees supported a nest of Barrow's Golden Eyes. These water birds are known to nest in tall trees overhanging the water. There were 5 live chicks seen with the parents after the second day at the lake and one egg was noted on the last day in about 3 m water depth below the tree that was leaning out over the lake. – July 2023

Photo 10. The First boulder counterclockwise in Zone 3. These big rocks in the water are not suitable for trout spawning**.**

Photo 11. The second boulder on shore in Zone 3.

Zone 4

Photo 12. Continuing counterclockwise around the lake, this is looking west from the start of Zone 4. A low potential for trout spawning.

Photo 13. Zone 4 looking east.

Photo 14. Representative habitat of Zone 4 showing the rocks in this zone very clearly. Not a high potential for trout spawning.

<u>Zone 5</u> - This zone has logs along the shore. There is a creek outlet.

Photo 15. This is at the west end of Zone 5. The creek outlet is where the logs stick out the farthest from shore.

Photo 16. Front view of the creek outlet with rafted logs along the shore – July 2023.

Photo 17. The arrow points to the camp that the crew stayed at as well as shows the outlet of the creek -July 2023.

Photo 18. The outlet stream with approximate centreline drawn in blue. The outlet creek has high potential for trout spawning. The camp can be seen at the top. Helicopter landing areas are indicted with an X.

<u>Zone 6</u> - potential for some spawning in zone 6

Photo 19. Typical shoreline habitat in Zone 6.

<u>Zone 7</u> - Rafted logs all along this zone along the southwest corner of the lake

Photo 20. Logs are along this whole section, with gravel on the shoreline.

Zone 8

Photo 21. Zone 8 along the south shore has gravel and cobble with dispersed, sunken logs. Some pockets of potential shone spawning habitat.

Photo 22. Looking east down zone 8. The boulder in this zone is shown.

Photo 23. A close-up of the boulder. Could be a good fishing place.

Zone 9 - Very Short Littoral zone, cobble, gravel and boulders on slope with lots of structure (boulders and logs), probably good fishing – negligible spawning potential

Photo 24. Typical habitat of Zone 9.

Photo 25. The west side of zone 9 looking west.

Photo 26. The boulder in Zone 9.

Photo 27. The east side of Zone 9. This part has spawning potential due to the gravel and cobble.

Zone 10 - Gravel patches with steep drop-off – Potential Spawning

Photo 28. Potential for spawning with gravel patches. There is a steep drop off along Zone 10.

Zone 11 - Short littoral zone, gravel and cobble, long slope. Some spawning potential

Photo 29. Cliff with steep drop-off. Rain at the time was making bubbles appear on the water surface.

Photo 30. Small creek on east side of cliff. July 2023

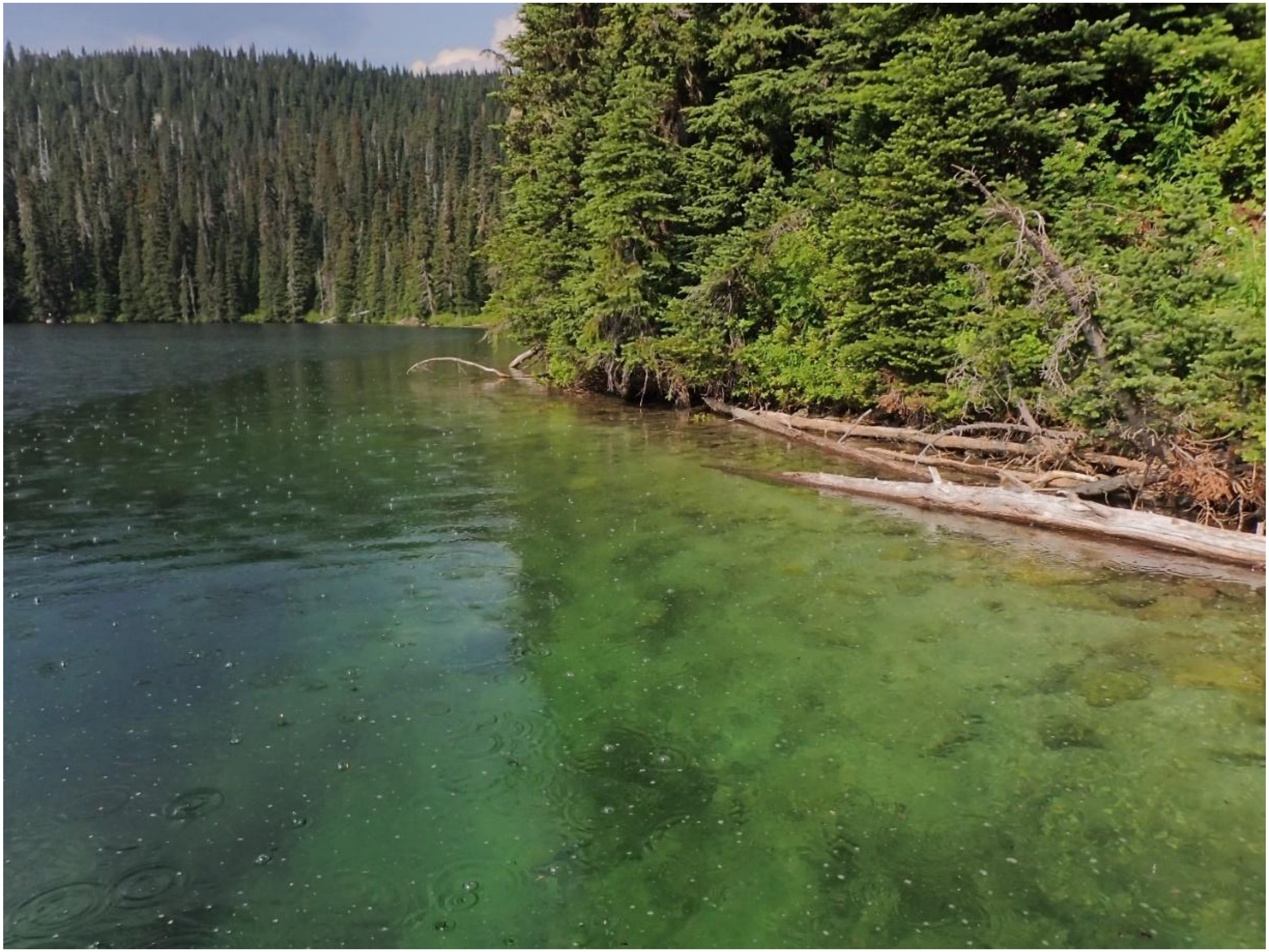


Photo 31. The east end of zone 11 in July 2023

Extras

Photos 32 and 33. Long toed salamanders were common around the lake and at the outlet creek in 2023. Larval stage in the photo on the right.

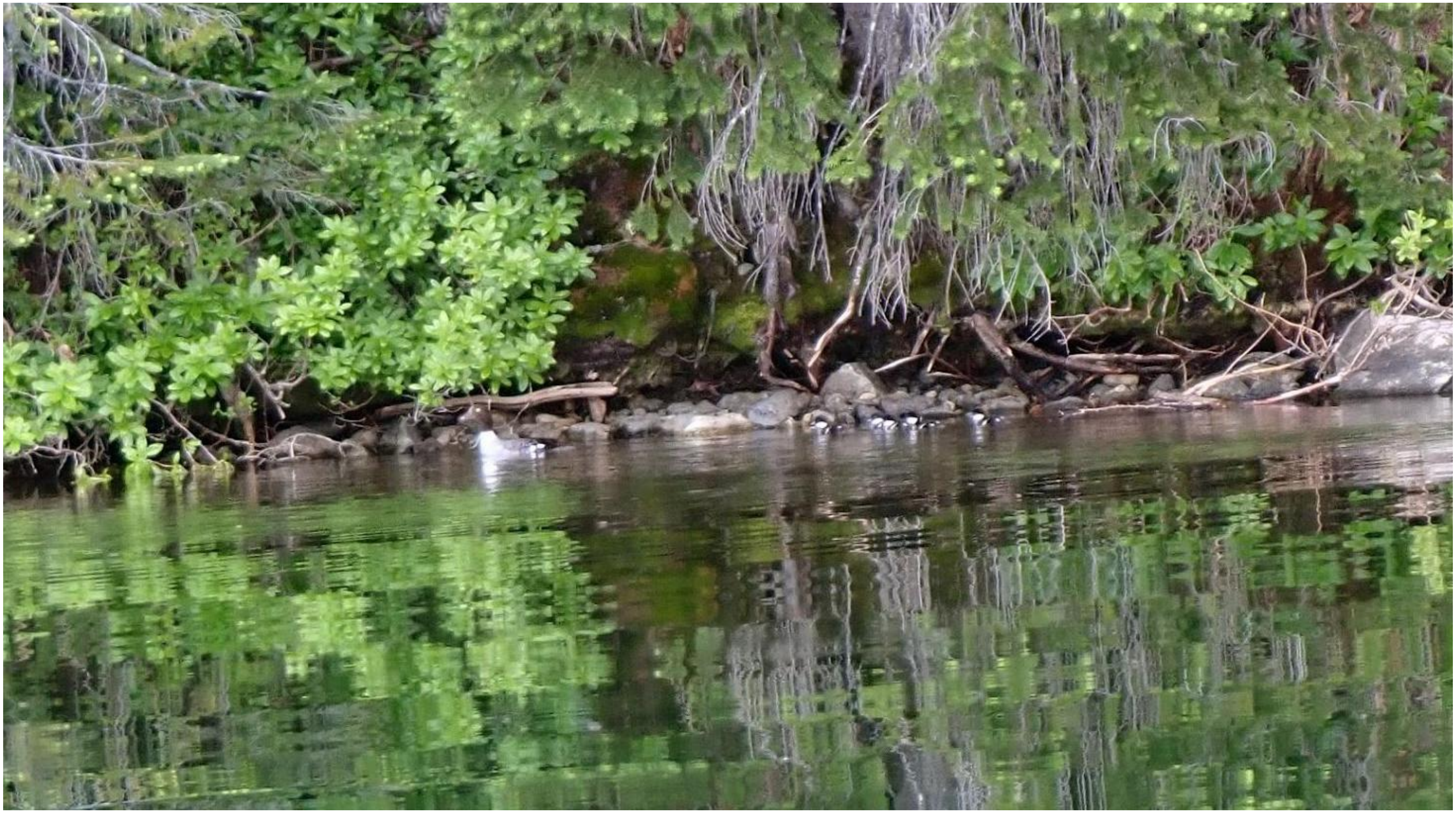


Photo 34. Barrow's Golden Eye mother with five chicks along the shore of Nk'pux Lake (July 7, 2023).

Photo 35. Panoramic view of Nk'pux Lake from the outlet stream facing towards Jackass Mountain. – July 2023

Photo 36. The helicopter landed on the ice on March 12, 2024. The snow depth was 80cm and the ice depth was 55cm. The hole was made right beside the helicopter due to running against time from the cloud cover closing in.

Photo 37. (Winter March 2024) The hole was dug and the equipment set up.

Photo 38. A look at the equipment used for sampling

Photo 39. July 2024 - The fire touched four places on the north shore of Nk'Pux Lake, the largest about 12 meters wide (others 3 meters).

Photo 40. A view of Jackass Mountain on July 22, 2024.

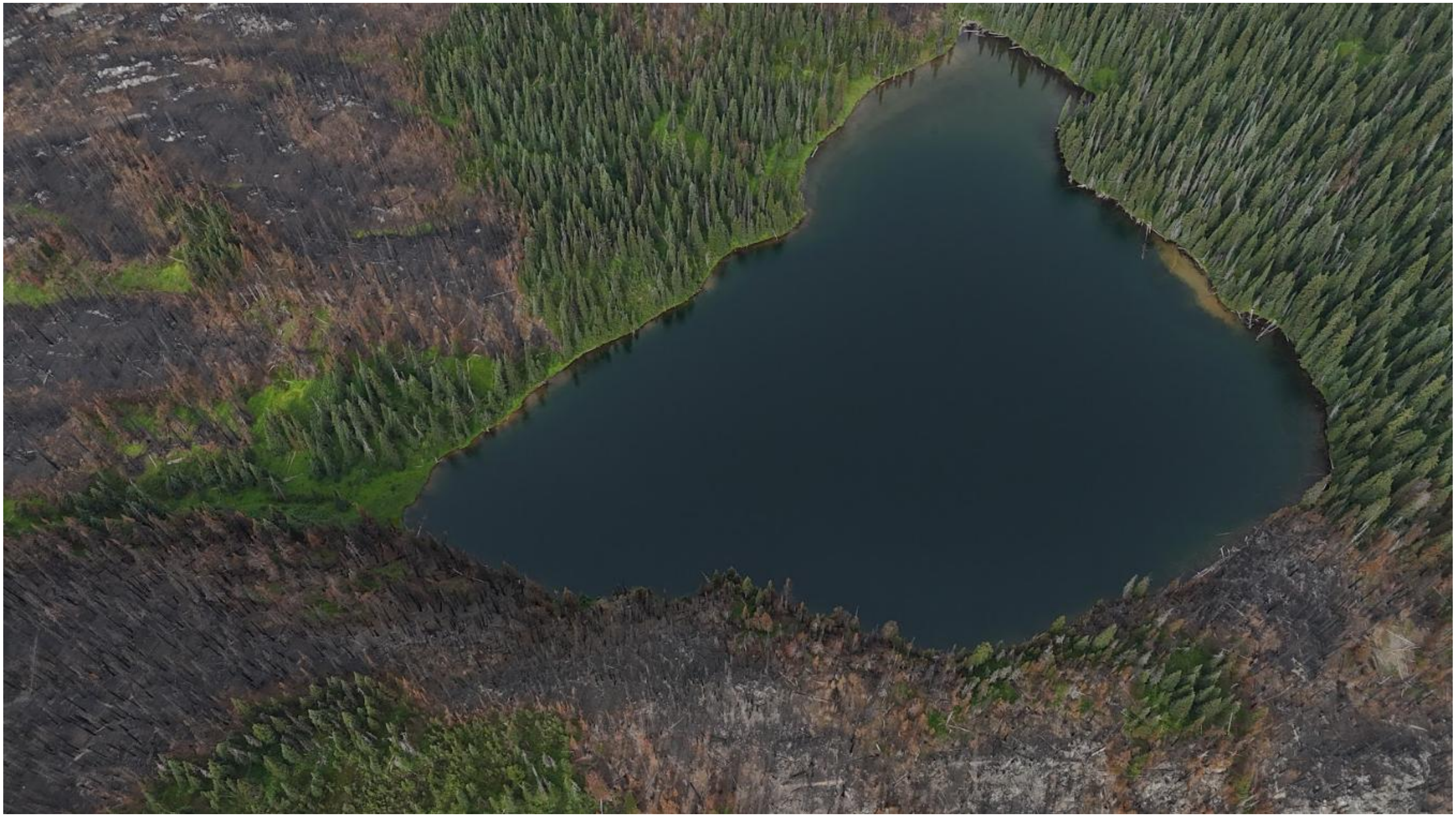


Photo 41. July 2024 - The other headwater lake of Siwash Creek.

Photo 42. The inlet creek of Nk'pux Lake goes through a wetland before going down a steep slope and into the lake (arrow)- July 2024

Photo 43. Potential fish spawning habitat beside the inlet stream. Benthic invertebrates were collected from here – July 2024

Photo 44. Creek inlet during July 2024

Photo 45. Creek inlet facing upstream. This area could be enhanced to improve fish spawning habitat – July 2024

Photo 46. Scuds and shrimp seen from benthic samples.

Photos 47 & 48. Zooplankton sample July 2024. Shrimp, rotifers and water fleas. Sampling equipment used for zooplankton is seen in the background.

Appendix B – Data Summaries

Table B1. A table of the invertebrates found in Nk'Pux Lake. These invertebrates are what will feed the stocked fish. Benthic means these invertebrates are in or on the lake bottom and zooplankton samples collected the invertebrates that were swimming around in the deep water column (away from shore).

Common Name	**Scientific Name**	**Number Found**	**Sample Type Found in**
Small Minnow Mayfly	Baetidae Family	1 483	Benthic
Green Stonefly (Sallfly)	Chloroperlidae Family	145	Benthic
Spring Stonefly	Nemouridae Family	151	Benthic
Northern Caddisfly	Limnephilidae Family	34	Benthic
Chironomids	Chironomidae Family	3 096	Benthic
Large Crane Fly	Tipulidae Family	97	Benthic
Dragonfly	Anisoptera Order	40	Benthic
Water Boatmen	Corixidae Family	20	Benthic
Darners	Aeshnidae Family	34	Zooplankton
Juvenile Copepods	Copepoda Nauplii Class	67 712	Zooplankton
Copepod	Cyclopidae Family	7 144	Zooplankton
Water Mites	Hydrozeptidae Family	143	Benthic
Water Flea	Cladocera Order	457	Benthic
Daphnia, Water Flea	Daphniidae Family	767	Zooplankton
Crustacean: Shrimp, Scuds, Sideswimmers	Amphipoda Order	3 486	Benthic
Scuds	Gammaridae Family	10 669	Benthic
Potworms	Enchytraeidae Family	463	Benthic
Sludgeworm-Like	Naididae Family	323	Benthic
Peaclam	Pisidiidae Family (Mollusc)	14	Benthic
Rotifer	Ploima Order	6 528	Zooplankton
Rotifer	Brachionidae Family	8 448	Zooplankton

Table B2. Water quality in several locations in and around Nk'Pux lake. The reading location, the date of the reading of July 2024, the Air Temp in degrees Celsius, the depth at which the reading was measured from the surface of the lake, the Water temperature the pH, the dissolved oxygen in mg/l and the percent Dissolved Oxygen. Some boxes are left blank due to not recording that data. pH of 6-9 is good, 9 and up is hard water. Lake Sample Site 1 was located just south of the creek inlet and Lake Sample Site 2 was located just north of the creek inlet. The bolded pH is most likely an outlier.

Reading location	**Date**	**Air Temp (°C)**	**Depth of reading**	**Temperature (°C)**	**pH**	**DO (mg/L)**	**DO%**
Outlet Creek 25m downstream of lake	22	25	Surface	19.8	7	Meter no functioning	
Inlet Creek	23		Surface	16.5 - 17	8.7	6.73	70.3
Deepest part of Lake	23		0m	18	7.3	7.18	76.3
Deepest part of Lake	23		8.5m	8.5	**9.22**		
Deepest part of lake	23		20m	4.8	7.44	8.58	67.6
Inlet Creek 1m upstream	25	10		11.5		8.59	75.9
Lake Sample site 3	25	10	Lake Bottom	15.9		7.19	73.1
Lake Sample Site 1	25	10		15.6		7.37	74.0

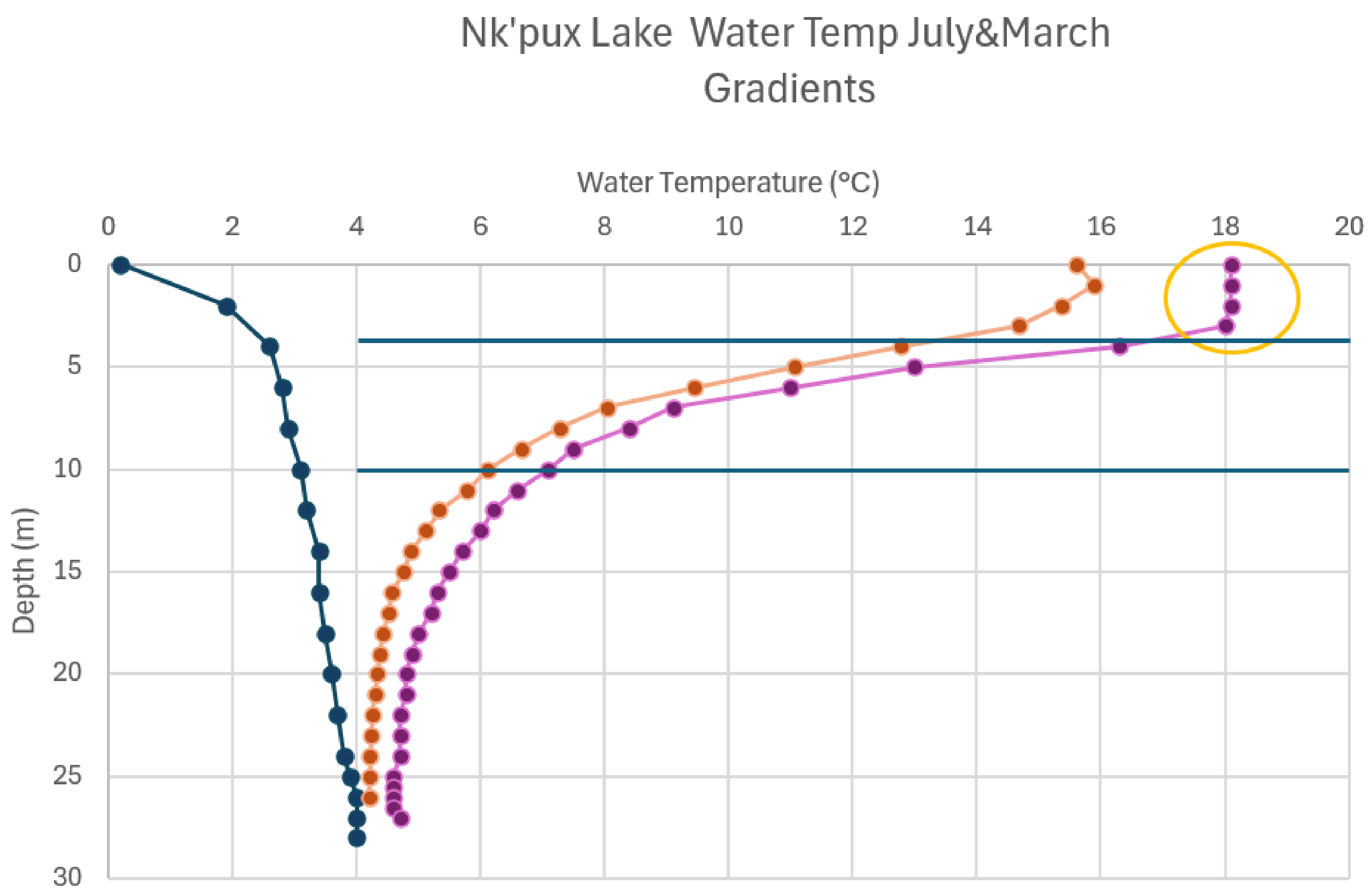


Figure B1. Nk'Pux Lake water temperature Gradient at the deepest part of the lake for Summer July 2023 (Orange), Winter March 2024 (Dark Blue) and Summer July 2024 (Magenta). Between the solid blue lines is the thermocline. A thermocline is where the temperature changes rapidly from warmer at the surface to colder in the depths and really only applies in the summer. The thermocline at this spot in the lake starts around 4 meters shown with the top solid blue line. The yellow circle shows that the temperature stays the same for the first 4 meters, this is partially due to the natural heat from the sun warming the surface of the lake. As for rainbow trout, they can survive between 0-29.8°C and perform optimally between 10-18°C (Jiang et al. 2021)(Molony 2001).

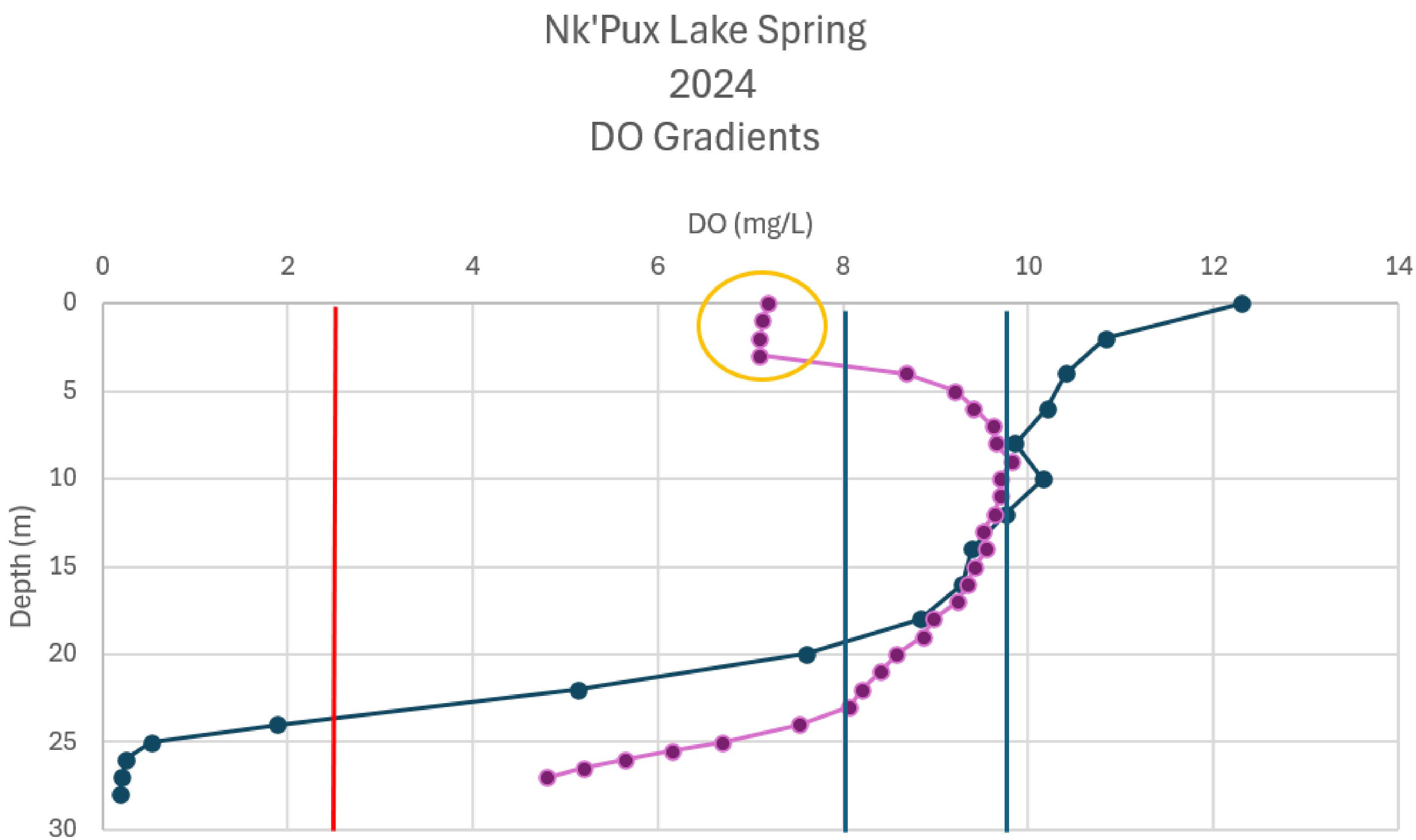


Figure B2. Nk'Pux Lake Dissolved Oxygen gradient at the deepest point in the lake, Winter March 2024 (Dark Blue) and Summer July 2024 (Magenta). Rainbow trout need above 2.5 mg/L of Dissolved Oxygen in water to survive, which is shown by the red line, meaning that in the winter the rainbows will stay above a depth of 24m (Swales 2006). The yellow circle shows where the higher temperature at the surface releases the oxygen into the air equalizing the oxygen level in air and water. This explains the decrease in dissolved oxygen at the surface.

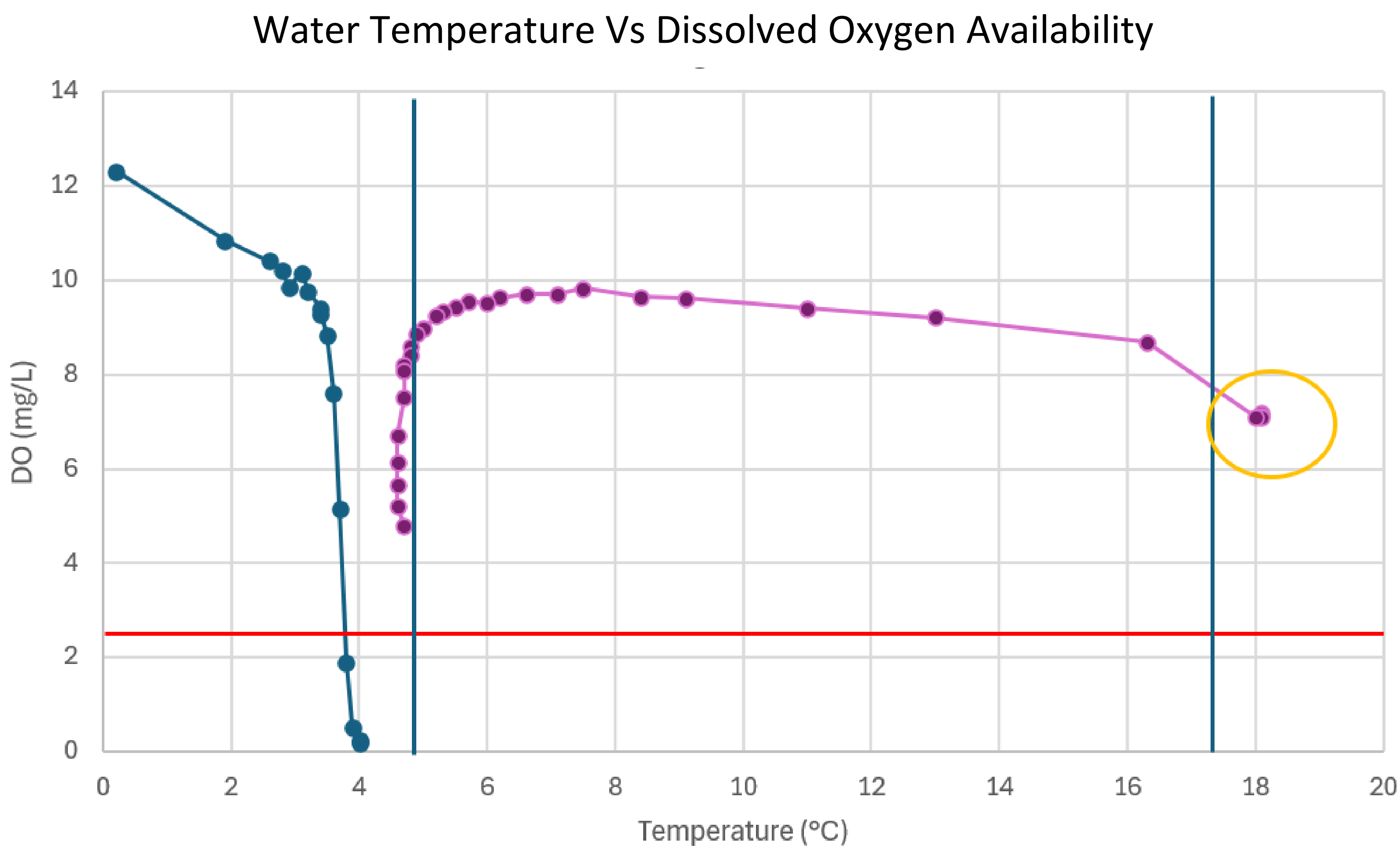


Figure B3. Blue is winter, magenta is summer 2024. Temperature is a variable that determines the dissolved oxygen levels in water. If there are no other variables than temperature, the data would have a negative relationship, that is a descending line, meaning the lower the temperature the higher the Dissolved Oxygen levels. The yellow circle shows where the higher temperature at the surface releases the oxygen into the air equalizing the oxygen level in air and water. This explains the decrease in dissolved oxygen at the surface.

Appendix C – Raw Data

CARO Analytical Services	**Client**	Arsenault Environmental
FINAL Analytical Testing Rpt	**Attention**	Darryl Arsenault
Work Order: 23G0986	**Project**	22-40
Report Date: 2023-08-17 09:	**Project Info**	[none]

Note: This is not the original data. Please refer to PDF / Hardcopy report.

LAB ID				23G0986-01	23G0986-02	23G0986-03	23G0986-04	23G0986-05
DATE SAMPLED				2023-07-08	2023-07-08	2023-07-08	2023-07-08	2023-07-08
DATE RECEIVED				2023-07-10	2023-07-10	2023-07-10	2023-07-10	2023-07-10
MATRIX				Water	Water	Water	Water	Water
CLIENT ID				Inlet Stream	Shallow Lake	Deep Lake	Outlet Strea	DUP
General Method	**Analyte**	**Units**	**MRL**					
Anions	Nitrate (as N)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Anions	Nitrite (as N)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Calculated Parameters	Hardness, Total (as CaCO3)	mg/L	0.5	10.8	6.19	6.29	6.27	6.22
Calculated Parameters	Nitrate+Nitrite (as N)	mg/L	0.01	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
Calculated Parameters	Nitrogen, Total	mg/L	0.05	<0.0500	0.06	<0.0500	0.076	0.066
General Parameters	Ammonia, Total (as N)	mg/L	0.05	<0.050	<0.050	<0.050	<0.050	<0.050
General Parameters	BOD, 5-day	mg/L	2	<5.6	<5.6	<5.6	6.5	<5.6
General Parameters	Nitrogen, Total Kjeldahl	mg/L	0.05	<0.050	0.06	<0.050	0.076	0.066
General Parameters	Phosphorus, Total (as P)	mg/L	0.005	0.006	0.0076	0.0056	0.0054	0.0074
General Parameters	pH	pH units	0.1	6.88	6.49	6.54	6.49	6.53
General Parameters	Conductivity (EC)	uS/cm	2	25.1	14.2	14.7	14.1	13.9
Total Metals	Aluminum, total	mg/L	0.005	0.0375	0.0364	0.0356	0.0325	0.0333
Total Metals	Antimony, total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Total Metals	Arsenic, total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Barium, total	mg/L	0.005	0.0076	0.0051	0.0054	0.0055	0.0054
Total Metals	Beryllium, total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Bismuth, total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Boron, total	mg/L	0.05	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Total Metals	Cadmium, total	mg/L	1E-05	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Calcium, total	mg/L	0.2	3.69	2.03	2.05	2.07	2.05
Total Metals	Chromium, total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Cobalt, total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

MATRIX				Water	Water	Water	Water	Water
CLIENT ID				Inlet Stream	Shallow Lak	Deep Lake	Outlet Strea	DUP
General Method	**Analyte**	**Units**	**MRL**					
Total Metals	Copper, total	mg/L	0.0004	<0.00040	0.00051	<0.00040	<0.00040	<0.00040
Total Metals	Iron, total	mg/L	0.01	0.035	0.012	0.03	<0.010	<0.010
Total Metals	Lead, total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Total Metals	Lithium, total	mg/L	0.0001	<0.00010	0.00014	0.00014	0.00012	0.00011
Total Metals	Magnesium, total	mg/L	0.01	0.379	0.272	0.284	0.263	0.263
Total Metals	Manganese, total	mg/L	0.0002	0.00139	0.00207	0.00408	0.00169	0.00176
Total Metals	Mercury, total	mg/L	1E-05	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Molybdenum, total	mg/L	0.0001	0.00074	0.00024	0.00021	0.00027	0.00027
Total Metals	Nickel, total	mg/L	0.0004	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Total Metals	Phosphorus, total	mg/L	0.05	<0.050	<0.050	<0.050	<0.050	<0.050
Total Metals	Potassium, total	mg/L	0.1	0.13	0.17	0.13	0.13	0.13
Total Metals	Selenium, total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Silicon, total	mg/L	1	1.5	1.2	1.2	1.3	1.2
Total Metals	Silver, total	mg/L	5E-05	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Total Metals	Sodium, total	mg/L	0.1	0.76	0.52	0.49	0.46	0.46
Total Metals	Strontium, total	mg/L	0.001	0.0205	0.0149	0.0154	0.0153	0.0154
Total Metals	Sulfur, total	mg/L	3	<3.0	<3.0	<3.0	<3.0	<3.0
Total Metals	Tellurium, total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Thallium, total	mg/L	2E-05	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Total Metals	Thorium, total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Tin, total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Total Metals	Titanium, total	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Metals	Tungsten, total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Metals	Uranium, total	mg/L	2E-05	0.000042	0.000109	0.000109	0.000104	0.000104
Total Metals	Vanadium, total	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Metals	Zinc, total	mg/L	0.004	<0.0040	0.0054	<0.0040	<0.0040	<0.0040
Total Metals	Zirconium, total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

CARO Analytical Services		**Client**	Arsenault Environmental
FINAL Analytical Testing Report		**Attention**	Darryl Arsenault
Work Order: 24C1670		**Project**	22-40
Report Date: 2024-11-22 16:19:47		**Project Info**	[none]

Note: This is not the original data. Please refer to PDF / Hardcopy report.

LAB ID				24C1670-01	24C1670-02	24C1670-03	24C1670-04
DATE SAMPLED				2024-03-12	2024-03-12	2024-03-12	2024-03-12
DATE RECEIVED				2024-03-13	2024-03-13	2024-03-13	2024-03-13
CLIENT ID				DUP - Bag 1 \	DUP - Bag 2 \	Surface WQ	Center of Lake
MATRIX				Water	Water	Water	Soil
General Method	**Analyte**	**Units**	**MRL**				
Anions	Nitrate (as N)	mg/L	0.01	0.074	0.013	<0.010	
Anions	Nitrite (as N)	mg/L	0.01	<0.010	<0.010	<0.010	
Calculated Parameters	Hardness, Total (as CaCO3)	mg/L	0.5	58.9	46.6	8.11	
Calculated Parameters	Nitrate+Nitrite (as N)	mg/L	0.01	0.0735	0.0131	<0.0100	
Calculated Parameters	Nitrogen, Total	mg/L	0.05	4.64	4.49	<0.0500	
General Parameters	Ammonia, Total (as N)	mg/L	0.05	0.328	0.249	<0.050	
General Parameters	BOD, 5-day	mg/L	2	<6.3	<6.3	<6.3	
General Parameters	Nitrogen, Total Kjeldahl	mg/L	0.05	4.57	4.48	<0.050	
General Parameters	Phosphorus, Total (as P)	mg/L	0.005	1.56	1.64	0.0077	
General Parameters	pH	pH units	0.1	7.54	6.12	6.17	
General Parameters	pH (1:2 H2O Solution)	pH units	0.1				8.76
General Parameters	Conductivity (EC)	uS/cm	2	24.1	20.4	21.9	
Strong Acid Leachable Metals	Aluminum	mg/kg dry	40				34100
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1				<0.10
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.3				4.71
Strong Acid Leachable Metals	Barium	mg/kg dry	1				164
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1				0.38
Strong Acid Leachable Metals	Boron	mg/kg dry	2				2.7
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04				0.124
Strong Acid Leachable Metals	Chromium	mg/kg dry	1				25.8
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1				13.1
Strong Acid Leachable Metals	Copper	mg/kg dry	0.4				60.9
Strong Acid Leachable Metals	Iron	mg/kg dry	20				26300
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2				3.51
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1				10.4
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4				387
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.04				0.059
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1				5.61
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.6				14.1
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.2				0.69
Strong Acid Leachable Metals	Silver	mg/kg dry	0.1				0.14
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2				72.9
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1				<0.10
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2				0.3
Strong Acid Leachable Metals	Tungsten	mg/kg dry	0.2				<0.20
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.05				13.5
Strong Acid Leachable Metals	Vanadium	mg/kg dry	1				78.6
Strong Acid Leachable Metals	Zinc	mg/kg dry	2				77.3
Total Metals	Aluminum, total	mg/L	0.005	36.2	29.2	0.039	
Total Metals	Antimony, total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	
Total Metals	Arsenic, total	mg/L	0.0005	0.00514	0.00434	<0.00050	
Total Metals	Barium, total	mg/L	0.005	0.212	0.171	0.0068	
Total Metals	Beryllium, total	mg/L	0.0001	0.00053	0.00042	<0.00010	
Total Metals	Bismuth, total	mg/L	0.0001	<0.00010	<0.00010	<0.00010	
Total Metals	Boron, total	mg/L	0.05	<0.0500	<0.0500	<0.0500	

CLIENT ID				DUP - Bag 1 \	DUP - Bag 2 \	Surface WQ
MATRIX				Water	Water	Water
General Method	**Analyte**	**Units**	**MRL**			
Total Metals	Cadmium, total	mg/L	0.00001	0.000217	0.000181	<0.000010
Total Metals	Calcium, total	mg/L	0.2	10.4	7.79	2.67
Total Metals	Chromium, total	mg/L	0.0005	0.0235	0.02	<0.00050
Total Metals	Cobalt, total	mg/L	0.0001	0.0126	0.0101	<0.00010
Total Metals	Copper, total	mg/L	0.0004	0.0683	0.0579	<0.00040
Total Metals	Iron, total	mg/L	0.01	22.9	17.1	0.017
Total Metals	Lead, total	mg/L	0.0002	0.0096	0.00506	<0.00020
Total Metals	Lithium, total	mg/L	0.0001	0.0114	0.00912	0.00011
Total Metals	Magnesium, total	mg/L	0.01	7.97	6.59	0.348
Total Metals	Manganese, total	mg/L	0.0002	0.474	0.34	0.00118
Total Metals	Mercury, total	mg/L	0.00001	0.000032	0.000065	<0.000010
Total Metals	Molybdenum, total	mg/L	0.0001	0.00535	0.00534	0.00028
Total Metals	Nickel, total	mg/L	0.0004	0.0144	0.0128	<0.00040
Total Metals	Phosphorus, total	mg/L	0.05	1.59	1.28	<0.050
Total Metals	Potassium, total	mg/L	0.1	1.5	1.38	0.25
Total Metals	Selenium, total	mg/L	0.0005	0.00072	0.00056	<0.00050
Total Metals	Silicon, total	mg/L	1	32.4	25.9	1.6
Total Metals	Silver, total	mg/L	0.00005	0.000223	0.000177	<0.000050
Total Metals	Sodium, total	mg/L	0.1	1.66	1.4	0.59
Total Metals	Strontium, total	mg/L	0.001	0.0943	0.0723	0.019
Total Metals	Sulfur, total	mg/L	3	<3.0	<3.0	<3.0
Total Metals	Tellurium, total	mg/L	0.0005	<0.00050	<0.00050	<0.00050
Total Metals	Thallium, total	mg/L	0.00002	0.000072	0.000065	<0.000020
Total Metals	Thorium, total	mg/L	0.0001	0.00016	0.0001	<0.00010
Total Metals	Tin, total	mg/L	0.0002	<0.00020	<0.00020	<0.00020
Total Metals	Titanium, total	mg/L	0.005	0.549	0.478	<0.0050
Total Metals	Tungsten, total	mg/L	0.001	<0.0010	<0.0010	<0.0010
Total Metals	Uranium, total	mg/L	0.00002	0.022	0.0176	0.0001
Total Metals	Vanadium, total	mg/L	0.005	0.0668	0.0548	<0.0050
Total Metals	Zinc, total	mg/L	0.004	0.0796	0.0737	0.0041
Total Metals	Zirconium, total	mg/L	0.0001	0.00075	0.00064	<0.00010

CORDILLERA CONSULTING
FRESHWATER INVERTEBRATE TAXONOMY

Project: Nk'pux Lake Baseline #22-40

Arsenault Environmental Consulting Ltd.
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	Zooplankton	Zooplanktor	Zooplankton	Benthic Inv	Benthic Inv	Benthic Invert
Sample:	Zoop1	Zoop2	Zoop3	BI1	BI2	BI3
Sample Collection Date:	24-Jul-24	24-Jul-24	24-Jul-24	25-Jul-24	25-Jul-24	25-Jul-24
CC#:	CC250145	CC250146	CC250147	CC250148	CC250149	CC250150
Richness Measures						
Species Richness	13	10	10	30	27	21
EPT Richness	1	0	0	7	10	3
Ephemeroptera Richness	1	0	0	2	3	1
Plecoptera Richness	0	0	0	3	6	2
Trichoptera Richness	0	0	0	2	1	0
Chironomidae Richness	0	0	0	11	9	10
Oligochaeta Richness	0	0	0	2	2	2
Non-Chiro. Non-Olig. Richness	13	10	10	17	16	9
Abundance Measures						
Corrected Abundance	29753	28217	32916	9040	4841	7080
EPT Abundance	7	0	0	380	685	860
Dominance Measures						
1st Dominant Taxon	Copepoda Na	Copepoda N	Copepoda Na	Gammarus	Gammarus	Gammarus
1st Dominant Abundance	20864	21504	25344	5040	2329	3300
2nd Dominant Taxon	Ploima	Ploima	Kellicottia lo	Amphipoda	Amphipoda	Amphipoda
2nd Dominant Abundance	3712	2304	4096	1060	986	1440
3rd Dominant Taxon	Kellicottia lo	Kellicottia lo	Cyclopidae	Heterotriss	Baetidae	Baetidae
3rd Dominant Abundance	2304	2048	2418	400	329	440
% 1 Dominant Taxon	70.12%	76.21%	77.00%	55.75%	48.11%	46.61%
% 2 Dominant Taxon	12.48%	8.17%	12.44%	11.73%	20.37%	20.34%
% 3 Dominant Taxon	7.74%	7.26%	7.35%	4.42%	6.80%	6.21%
Percent Dominance	90.34%	91.64%	96.79%	71.90%	75.28%	73.16%
Community Composition						
% Ephemeroptera	0.02%	0.00%	0.00%	2.65%	10.35%	11.58%
% Plecoptera	0.00%	0.00%	0.00%	1.11%	3.51%	0.56%
% Trichoptera	0.00%	0.00%	0.00%	0.44%	0.29%	0.00%
% EPT	0.02%	0.00%	0.00%	4.20%	14.15%	12.15%
% Diptera	0.00%	0.00%	0.00%	20.13%	10.60%	12.99%

% Oligochaeta	0.00%	0.00%	0.00%	2.43%	3.84%	5.37%
% Baetidae	0.00%	0.00%	0.00%	2.43%	9.15%	11.58%
% Chironomidae	0.00%	0.00%	0.00%	19.03%	9.42%	12.99%
% Odonata	0.00%	0.00%	0.00%	0.44%	0.29%	0.28%
Functional Group Composition						
% Predators	0.00%	0.00%	0.00%	0.24%	0.37%	0.21%
% Shredder-Herbivores	0.00%	0.00%	0.00%	0.03%	0.12%	0.03%
% Collector-Gatherers	0.11%	0.10%	0.07%	4.28%	6.26%	4.51%
% Scrapers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Macrophyte-Herbivore	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Collector-Filterer	1.06%	1.15%	1.03%	0.17%	0.12%	0.21%
% Omnivore	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Parasite	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
% Piercer-Herbivore	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Gatherer	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Unclassified	0.89%	0.58%	0.52%	0.08%	0.04%	0.00%
Functional Group Richness						
Predators Richness				10	7	5
Shredder-Herbivores Richness				2	4	2
Collector-Gatherers Richness	3	1	1	14	15	13
Scrapers Richness						
MH Richness						
CF Richness	1	1	1	1	3	2
OM Richness						
PA Richness						1
Piercer-Herbivore Richness						
Gatherer Richness						
Unclassified	9	8	8	3	1	
Voltinism Composition						
% Univoltine	0.00%	0.00%	0.00%	0.44%	1.18%	0.00%
% Semivoltine	0.00%	0.00%	0.00%	0.88%	2.05%	0.56%
% Multivoltine	0.00%	0.00%	0.00%	0.66%	0.89%	0.56%
Voltinism Richness						
Univoltine	0	0	0	1	1	0
Semivoltine	0	0	0	2	3	2
Multivoltine	0	0	0	1	1	1
Diversity/Evenness Measures						
Shannon-Weiner H' (log 10)	0.69	0.61	0.53	0.76	0.83	0.81
Shannon-Weiner H' (log 2)	2.29	2.04	1.74	2.53	2.75	2.7
Shannon-Weiner H' (log e)	1.59	1.41	1.21	1.75	1.91	1.87
Simpson's Index (D)	1.25	1.33	1.41	0.36	0.29	0.27
Simpson's Index of Diversity (1 - D)	-0.25	-0.33	-0.41	0.64	0.71	0.73

Simpson's Reciprocal Index (1/D)	0.8	0.75	0.71	2.78	3.47	3.67
Biotic Indices						
Hilsenhoff Biotic Index	8	8	8	5.82	5.46	5.89